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(54) Title of invention: Forming method of separation walls for plasma display

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PATENT SPECIFICATION

1. TITLE OF INVENTION
Forming method of separation walls for plasma display

2. CLAIM
Forming method of separation walls for plasma display which is characterized by conducting;
(a) preparation of a jig having grooves that are laid out in identical shape with the separation walls of plasma display,
(b) filling the grooves with separation wall forming material,
(c) temporarily adhering the separation wall forming material to a base member having base glass,
(d) then, baking to form the separation walls.

3. DETAILED DESCRIPTION OF THE INVENTION

[Field of industrial applications]
This invention concerns production method of plasma display, especially a method to form separation walls of the plasma display.

[Prior technologies]
Previously, there have been technologies as described in the following, for example, in this field.

Figure 2 is a constitutional drawing of this type of previous plasma display, and Figure 2 (a) is its partially broken oblique view drawing, Figure 2 (b) is its partial plan view drawing, and Figure 2 (c) is its cross sectional drawing.

As shown in these drawings, this type of plasma display has a structure that multiple upper electrodes (anode electrodes) 3 are located on bottom surface of upper glass 1, lower electrodes (cathode electrodes) 4 are located on top surface of lower glass 2 opposing them and in matrix shape, they are separated with walls 5, the circumference is sealed to be high vacuum, and inside of it is substituted with rare gas such as Ne. Where, by applying high power electricity* between an anode electrode and a cathode electrode, atoms in the rare gas are excited and by the ionized glow discharge near the cathode electrode, photon (discharge light) is emitted. A device that use this light emission is so called DC type plasma display, and the discharge continues as long as the electric field is applied. In the drawing 6 is a discharge cell.
** Translator's note: This "power" could be a mistake of "voltage" or "field".*
This plasma display uses about 2 to 3 mm thick glass and the cathode electrodes and the separation walls are formed with thick layer printing respectively, and it has a structure that two sheets of glass are assembled after printing, drying and baking, then the circumference is sealed for high vacuum and inside is substituted with rare gas such as Ne.

Figure 3 is a production process chart of the base member of previous plasma display, and based on this drawing the method for forming the cathode electrodes is explained.

At first, terminals for the connection with outside are printed using Ag (silver) paste on a glass plate (base glass) 10 as shown in Figure 3 (a) to form Ag pattern 11.

Then as shown in Figure 3 (b), Ni (nickel) 12 is printed which becomes cathode electrodes after drying the Ag, and drying and baking are applied to form Ni pattern 12. Either of printing

of Ag or Ni may be done first.

Then as shown in Figure 3 (c), glass pattern 13 is printed in order to fill the area between the Ni pattern 12 and the Ni pattern 12. This process is done for preventing generation of steps in the separation wall in the next process.

Then as shown in Figure 3 (d), separation walls 14 are formed which are for separating electrodes. This process is to coat the material that is able to become separation walls over and over by printing, and they are formed by repeating printing, drying and baking for 6 to 10 times.

This process of the Figure 3 (d) is a process that requires labor and time and also because overlaying printings at the same spot for many times, preciseness of the machine and preciseness related with printing (printing screen, for example) are very important factors. Silk screen printer is used for the above described thick layer printing.

A silk screen printing is to mount cloth (silk screen) which is woven with fiber of such as silk, Nylon or Tetron, or wire of such as stainless steel, in a frame and tension and fix four edges, plug the openings of area other than necessary image by making a pattern film by manual or optical (photographic) method on it, place printing paste in the frame; and when inside surface of the screen is rubbed with pressure with a spatula shape rubber plate which is so-called as squeegee, the paste is pushed out through a part of the screen, where the pattern film does not exist, onto paper or other printing surface and printing is done. Forming of the pattern is done by this printing technology. When the separation walls are made with this thick film printing technology, the thickness is built up by repeating several times of printings, because the thickness is not obtained with a single layer of printing. In this case, preciseness of the printer and preciseness of printing screen is very important.

[Problems that the invention is to solve]

Because the separation walls are repeatedly printed for several times in said production method of plasma display, there have been a problem that the accuracy of overlaying is poor due to such as elongation of printing screen, accuracy of registration of glass at printing, and preciseness of printer, and the separation walls do not printed well and it becomes waste.

The objective of this invention is to remove the problem that overlaying accuracy gets poor at the forming of separation wall to cause waste as described above, improve the accuracy of forming of the separation walls, and provide a forming method of separation walls of plasma display in stable quality.

[Means to solve the problems]

In order to solve the above described problem, in production method of separation walls of plasma display, this invention is to prepare a jig having grooves that are laid out in identical shape with the separation walls of plasma display, fill the grooves with separation wall forming material, temporarily adhere the separation wall forming material to a base member having base glass, and bake to form the separation walls.

[Function]

According to this invention, as described in above in the forming method of separation walls for plasma display, without using the separation wall forming method with previous thick film printing using paste, a jig having grooves that have been formed ahead of time in the same dimensions with the shape of the separation walls is used instead of the paste, the separation wall forming material is filled in the grooves of the jig, and said jig is contacted with a base member having a glass base that has been coated with the glass paste ahead of time. After this, the jig is

removed form the base member and the separation wall forming material and the base member are completely bonded by applying a baking.

[Embodiment examples]

Figure 1 is a cross sectional drawing of production process of plasma display showing an embodiment example of this invention.

Where, the shape of the separation walls that are formed on the base glass is formed in a ratio of 2 in height to 1 in width. For example, when the width is 0.1 mm, the height shall be 0.2 mm.

Therefore, as shown in Figure 1 (a), a jig 20 is prepared which is a mold formed with grooves 20a wherein the material in this shape (hereafter called as separation wall material) is filled in and aligned in identical spacing. The material of this jig 20 is ceramics or glass, for example, and the grooves 20a are formed with etching.

Then Ni pattern 24 and glass pattern 25 are alternatively formed on a base glass 23 (refer to Figure 3 (c)), and further as shown in Figure 1 (b), low melting point glass 26 is selectively formed over those with silk screen printing. A base member 22 is prepared that is obtained by drying in this state (120 °C for 10 to 20 minutes) and further applying preliminary baking (400 °C for 10 minutes), and applying baking (450 °C for 10 minutes) after this. On the other hand, the separation wall material 21 is enclosed in the grooves 20a of the jig 20.

Then as shown in Figure 1 (c), the base member 22 is pressed against the jig 20 which is filled with the separation wall material 21, so that the separation wall material 21 and the base member 22 are jointed.

Then as shown in Figure 1 (d), the base member that is mounted with the separation wall material 21 is baked and after the separation wall material 21 and the base member 22 are completely adhered, the jig 20 is removed. The baking temperature in this case is about 580 °C and the baking time is about one hour. When the separation wall is thus made, it is able to be formed in several times faster time compared to the previous method.

Further, as the material for the separation walls, it is able to mention such as glass fiber from the standpoint that it should withstand high pressure and high temperature, it has good contact with Ni patterns and glass patterns which are underneath of them, it does not have conductivity, etc..

In the following, the second embodiment example is described.

In this embodiment example, instead of placing the low melting point glass 26 on the layers of Ni pattern 24 and glass pattern 25 as shown in Figure 1 (b), but low melting point glass 30 is formed on the separation wall material 21 as shown in Figure 4. In this case, when the width of separation wall material 21 is a, and the width of low melting point glass 30 is b, it is constituted to be $a > b$. Where, the low melting point glass 30 is easily applied with silk screen printing. After the application of the silk screen printing, drying, preliminary baking and baking are done as described above.

In the following, the third embodiment example is described referring to Figure 5.

As same as above described examples, the shape of the separation walls that are formed on the base glass is formed in a ratio of 2 in height to 1 in width. For example, when the width is 0.1 mm, the height shall be 0.2 mm. The groove 40 which is in this shape is formed as shown in Figure 5 (a) and using a jig 40 that comprises this grooves 40a are aligned in a same spacing, the separation wall forming material 41 that has been made into paste shape is painted into the grooves 40a as shown in Figure 5 (b), it is pressed with entire frame 40 against the base member 42 that has the base glass 43, Ni pattern 44 and glass pattern 45 as shown in Figure 5 (c), so that

the jig 40 and the base member 42 will completely contact. Baking is done in this condition to evaporate solvent in the separation wall forming material and harden it. The temperature at this is about 580 °C and time is about one hour. Then, as shown in figure 5 (d), it is separated into the frame 40 and the base member 42 after baking.

When forming of the separation wall is done with above described method, it is able to be done within a fraction of time compared with the previous method.

The material for the separation walls is required to withstand high temperature and high pressure, have good contact with the base Ni pattern and glass pattern, and have a property of insulation, and such as glass and ceramics are suitable. Further, there is a concern that the jig is adhered to the separation wall forming material, therefore, materials to which the separation wall forming material would not adhere or easily removed is used.

Further, this invention shall not be limited within above described embodiment examples, and various variations are possible based on the principle of this invention, and it does not exclude these from the range of this invention.

[Effect of the invention]

As above explained in detail, according to this invention, it is able to do the formation of separation walls in one process, because it is designed that identical shape ones with the separation walls that is going to be formed on base glass is made ahead of the time with separation wall forming material, and the separation walls are formed by contacting the separation wall forming material to the base glass by using a jig having cut grooves wherein the separation wall forming material can be enclosed and aligned in an identical spacing.

Accordingly, the overlay printing is no longer necessary in manufacturing process and preciseness of the separation walls is improved as well as labor saving of process is realized, therefore, it is able to realize the improvement of quality, increase of productivity and reduction of cost.

4. Brief explanation of drawings

Figure 1 is a cross sectional drawing of process of plasma display showing the embodiment example of this invention, Figure 2 is a constitutional drawing of previous plasma display, Figure 3 is a drawing of previous manufacturing process of a base member of plasma display, Figure 4 is a cross sectional drawing of major part of plasma display showing the second embodiment example of this invention, and Figure 5 is a cross sectional drawing of plasma display showing the third embodiment example of this invention.

20, 40: Jig, 20a, 40a: groove, 21, 41: separation wall forming material, 22, 42: base member, 23, 43: base glass, 24, 44: Ni pattern, 25, 45: glass pattern, 26, 30: low melting point glass.

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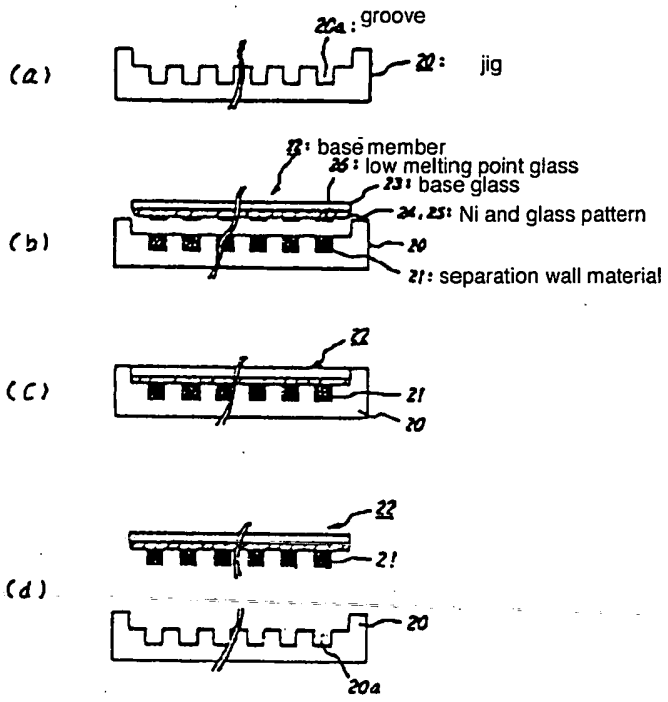
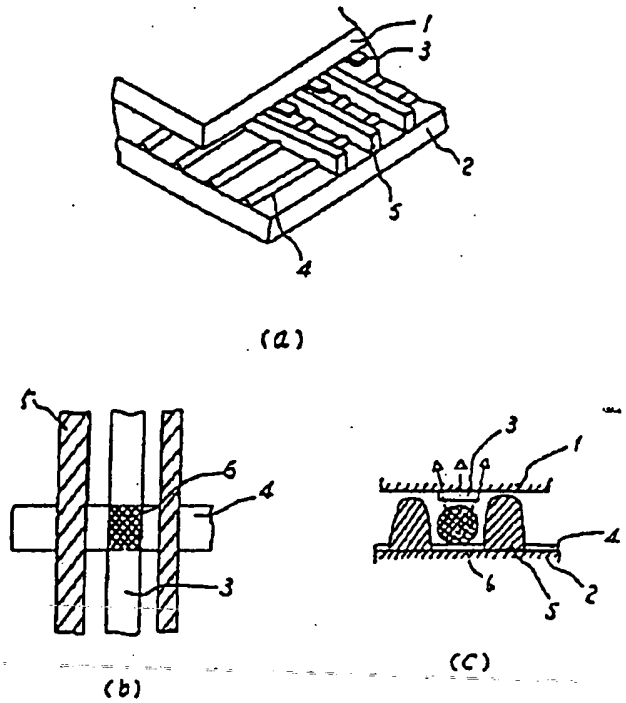
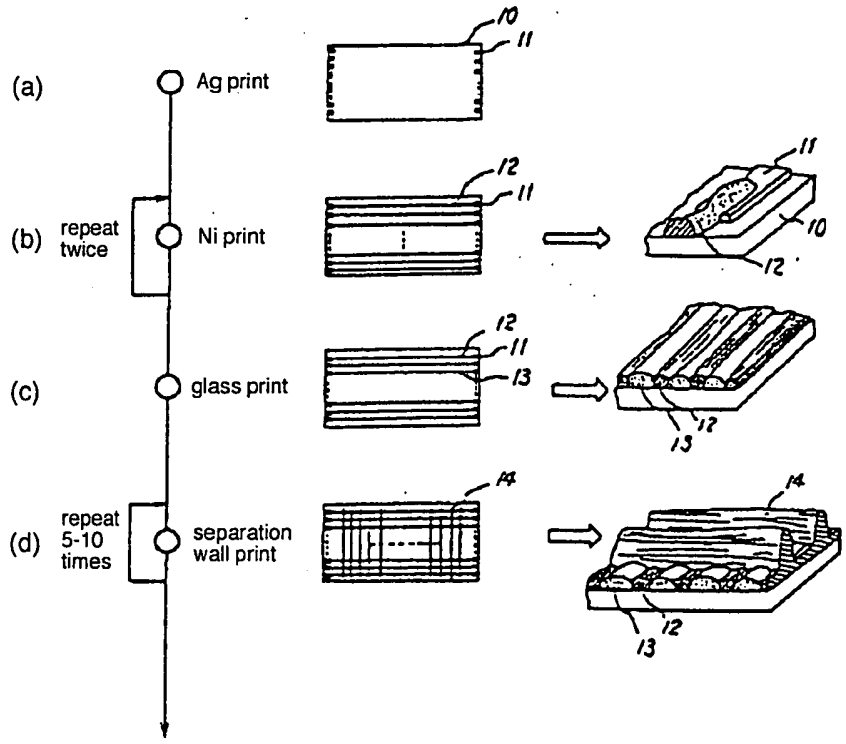


Figure 1



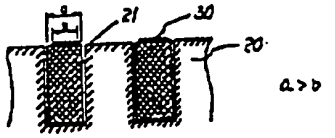
Constitutional drawing of previous plasma display

Figure 2



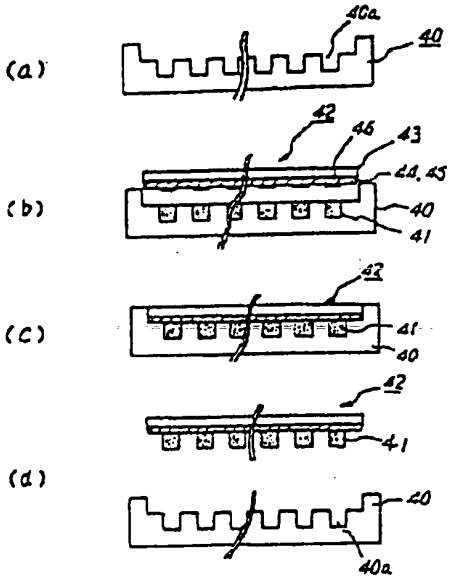
Previous production process drawing of the base of plasma display

Figure 3



Cross sectional drawing of production process of the second embodiment example of this invention

Figure 4



Cross sectional drawing of production process of the third embodiment example of this invention

Figure 5